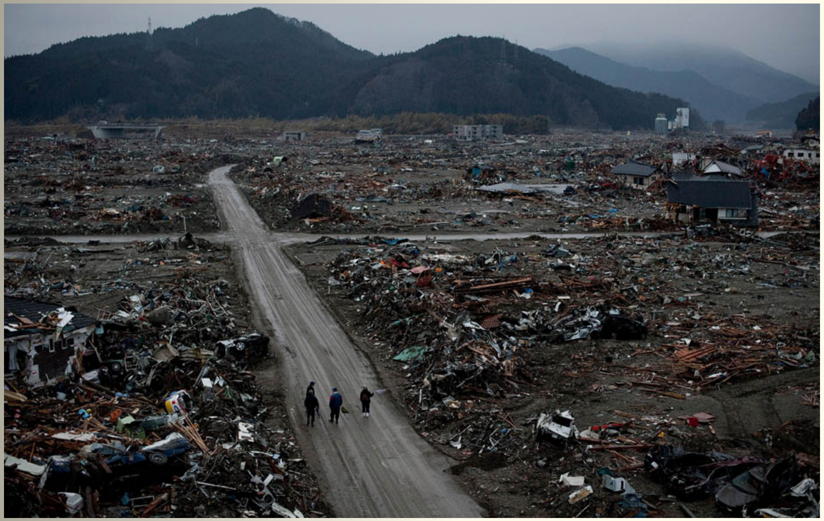
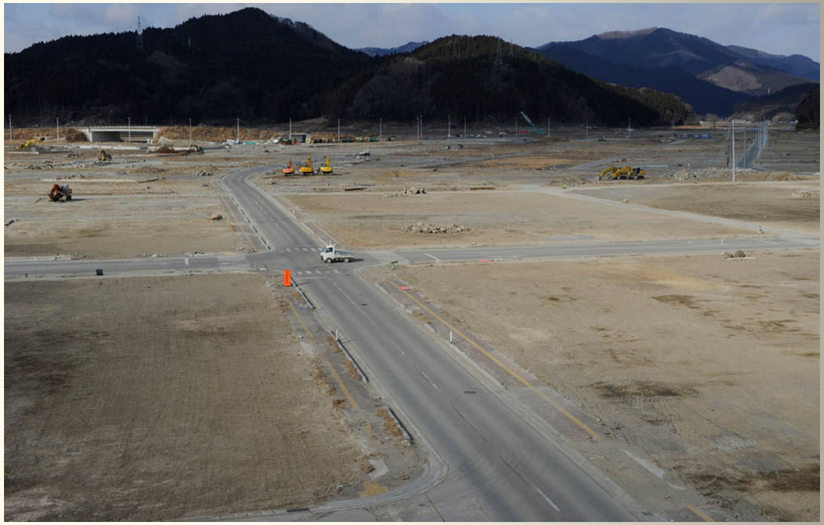
Revisiting the 3.11 Tohoku Earthquake & Tsunami – Lessons Learned 1 Year Later



Ofunato, Japan – March 2011

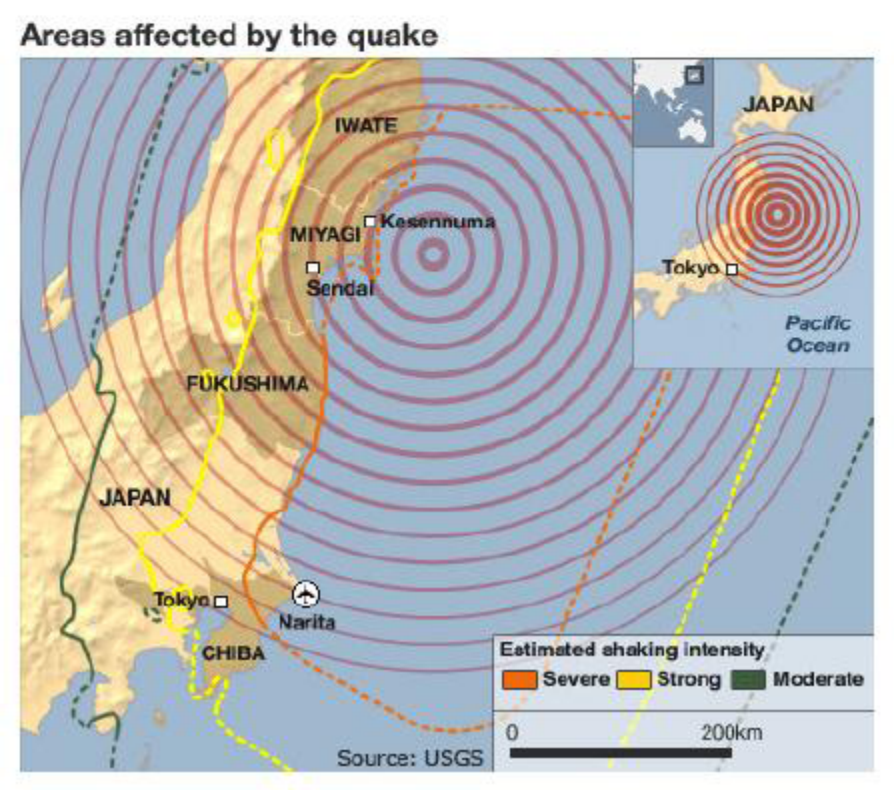


Ofunato, Japan – February 2012

John Schelling
Earthquake/Tsunami Program Manager
Washington Emergency Management
john.schelling@mil.wa.gov

- **www.emd.wa.gov**

Summary of the March 11 earthquake



Source: OCHA Situation Report No.1

Date and Time:
11 March 2011 at 14:46 JST (5:46 GMT)

Type of earthquake:
Plate-boundary thrust-faulting earthquake on or near the Japan Trench Subduction zone

Hypocenter:
130km off the Pacific coast of Tohoku region (38°N, 142°E), 24km depth

Magnitude:
9.0 (the largest in Japan and the 4th largest world)
c.f. 2004 Sumatra Earthquake M9.1

Damage:
The destruction of social infrastructure, housing and corporate facilities would cost between $250B (US dollars) for non-nuclear related costs

STATISTICS FROM 3.11

- 15,850 dead 3,281 still missing (as of 15th Feb 2012)
- 65% victims over 60 years old, 90%+ died from drowning
- Most Japanese houses became dislodged when water levels reached 2m and over.
- Some Coastal areas subsided up to 1.2m and there was Eastward displacement of max of 5m
- Sea did not pull back before Tsunami because sea trench facing Japanese coast lifted not sank
- Initial wavefront was not as high as subsequent wave because upward displacement of seabed started gradually then jumped.

Bet you didn't know that…

95%+ of population within the tsunami hazard zone survived!

-Meg Sugimoto
Tokyo University

It begs the question…

WHY?

Lesson #1

Having a plan (*and practicing it*) works!

Tsunami Education = Lives Saved

"Children at the school had received tsunami training the Friday before the tsunami. When the teachers felt the quake, they led the children out the back of the school and up the hill"
"It saved the school,"
"Thank God those teachers knew what they were doing."

- Peter Gurr of Maota, Samoa, 2009

Source: Kamaichi city

"The pre-disaster education guided the pupils at primary and junior high schools in Ishinomaki-city (one of the cities completely washed away) to safety during the tsunami. Miszuhama area in Ishinomaki has a total of 380 residents and about 130 households. However, only one person died and eight remain missing. It has been revealed that ***the people's awareness of what do do at the event of an earthquake and regular conduct of (tsunami evacuation) exercises/drill had helped them***"

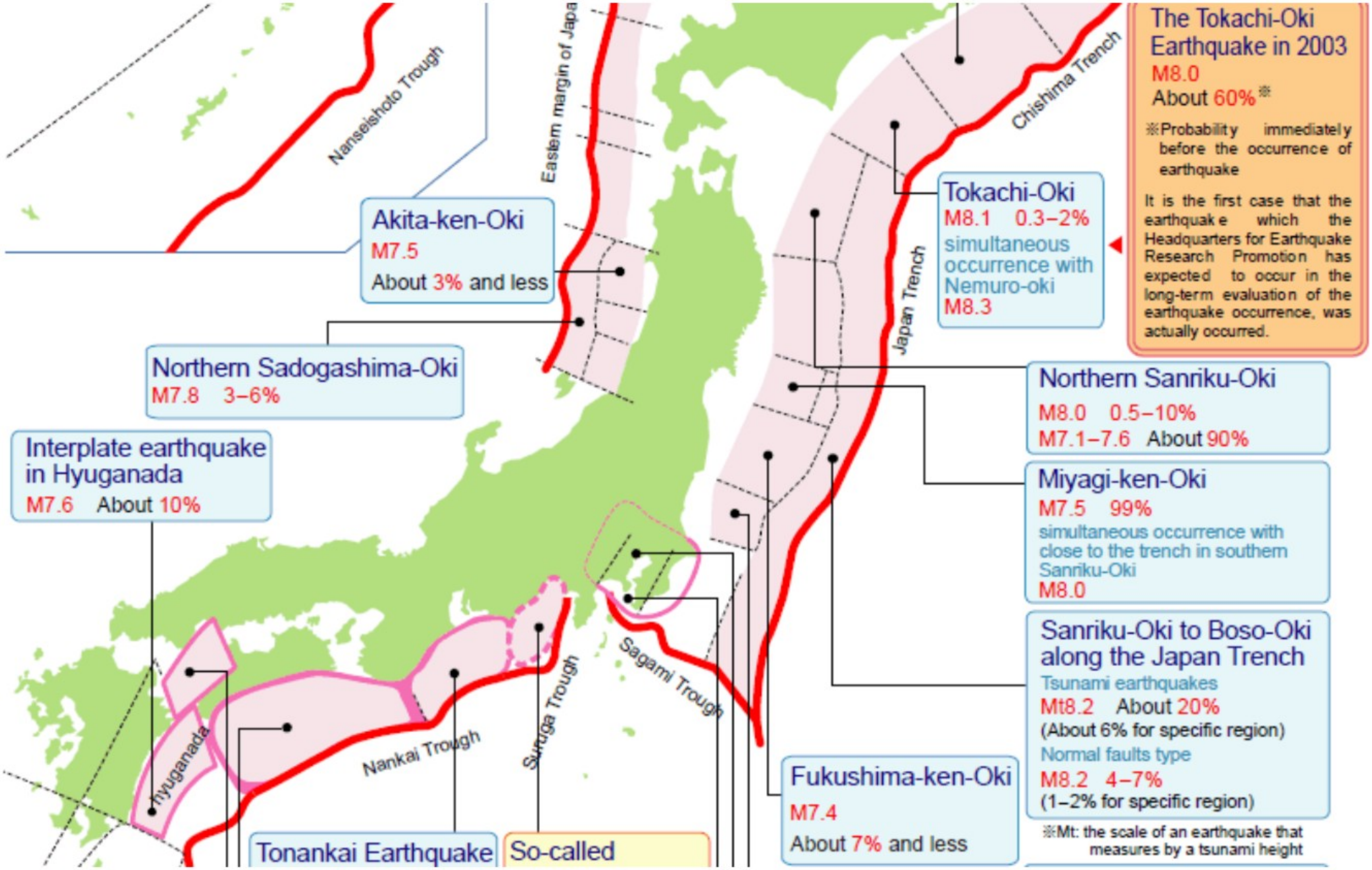
-Mr A. Koresawa, Asian Disaster Reduction Center
-Dr. Y. Kawaki, International Recovery Platform , Japan 2011

Quinault Indian Nation
Yellow Brick Road Walking Challenge

Lesson #2

We must plan for the POSSIBLE, not just the PROBABLE!

HAZARD MAP January 2011



The Tokachi-Oki Earthquake in 2003
M8.0
About 60%※

※Probability immediately before the occurrence of earthquake

It is the first case that the earthquake which the Headquarters for Earthquake Research Promotion has expected to occur in the long-term evaluation of the earthquake occurrence, was actually occurred.

Tokachi-Oki
M8.1 0.3–2%
simultaneous occurrence with Nemuro-oki
M8.3

Akita-ken-Oki
M7.5
About 3% and less

Northern Sadogashima-Oki
M7.8 3–6%

Interplate earthquake in Hyuganada
M7.6 About 10%

Northern Sanriku-Oki
M8.0 0.5–10%
M7.1–7.6 About 90%

Miyagi-ken-Oki
M7.5 99%
simultaneous occurrence with close to the trench in southern Sanriku-Oki
M8.0

Sanriku-Oki to Boso-Oki along the Japan Trench
Tsunami earthquakes
Mt8.2 About 20%
(About 6% for specific region)
Normal faults type
M8.2 4–7%
(1–2% for specific region)

※Mt: the scale of an earthquake that measures by a tsunami height

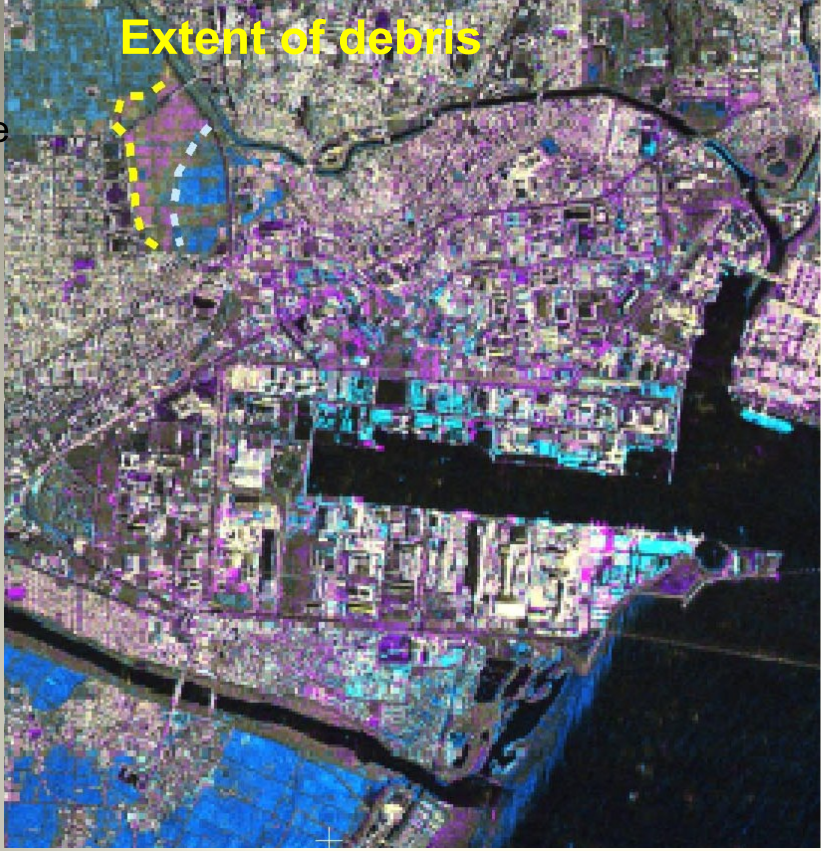
Fukushima-ken-Oki
M7.4
About 7% and less

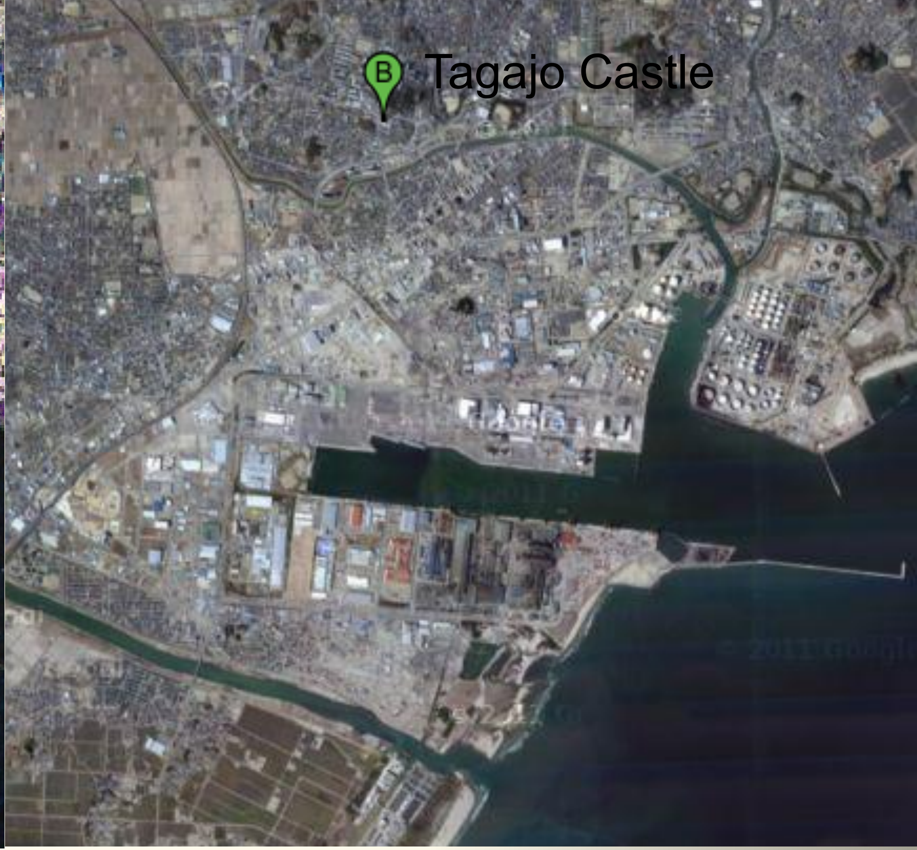
Tonankai Earthquake

So-called

http://www.jishin.go.jp/main/img/w_shokai-e_kaiko.gif

© 2010 German Aerospace Center (DLR).





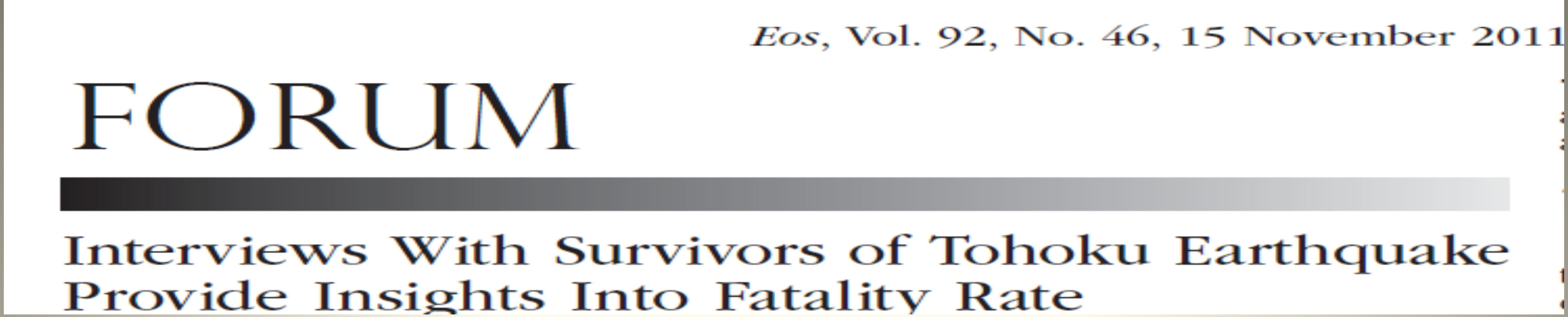
Tsunami Catalogue for the Sanriku District near the Sendai Area, mostly based upon Miyagi Showa Shinsho-Shi (Record of the Showa Earthquake and Tsunami in Miyagi Prefecture) and partially on Shuto's memory

In 869. Giant earthquake in the Tohoku District. Tsunami flooded up to the Tagajo castle near Sendai. Over 1,000 drowned.

Source: Tim Walsh, WA DNR

Lesson #3

Understanding "*Nature's Warnings*" is critical to survival!



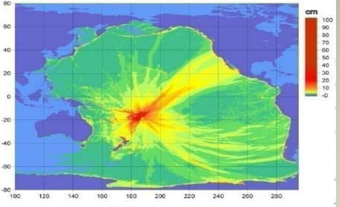
Eos, Vol. 92, No. 46, 15 November 2011

FORUM

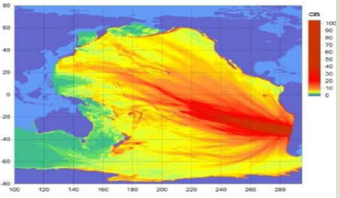
Interviews With Survivors of Tohoku Earthquake Provide Insights Into Fatality Rate

"Many interviewees did not understand the generation of tsunamis and thus did not realize they needed to evacuate to safer areas immediately. In particular, although they understood that tsunamis are associated with earthquakes, they did not understand how a tsunami happens. Had they known, while they were feeling the strong shaking, that an abrupt vertical seafloor deformation displaces the enormous amount of seawater overlying it, they might have evacuated more quickly to safer highlands."

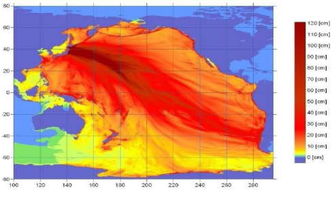
Source: M. Ando, M. Ishida, Y. Nishikawa, C. Mizuki, and Y. Hayashi



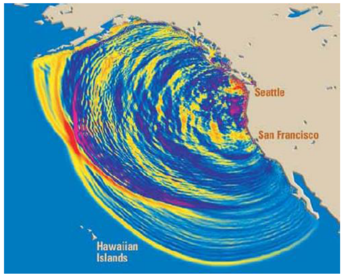
2009 Samoa



2010 Chile



2011 Japan

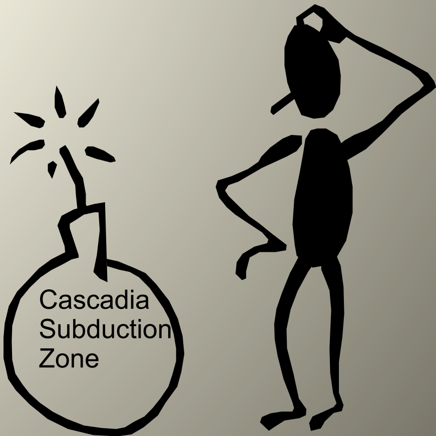


20?? United States

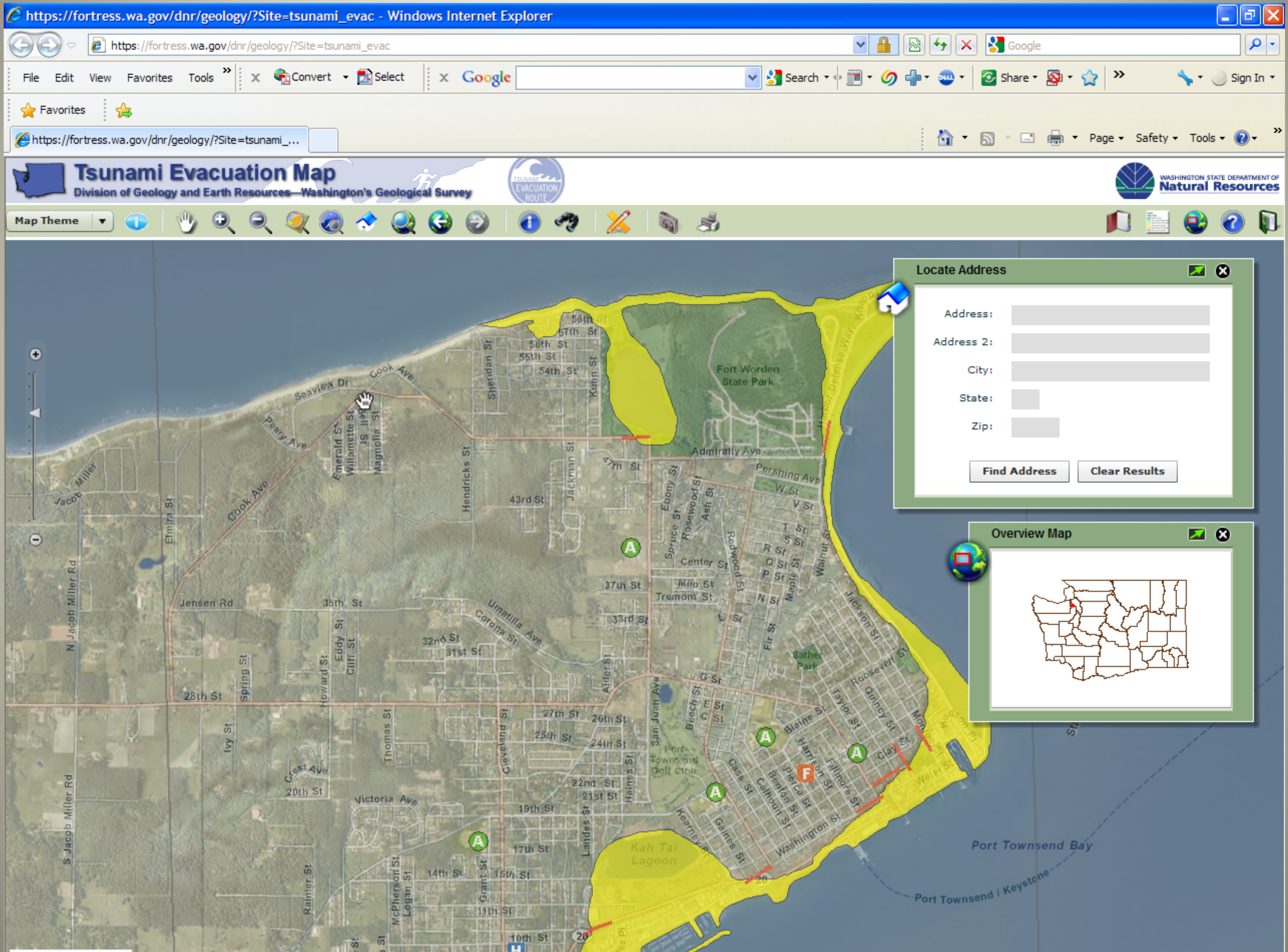
- **DISTANT** Tsunamis:
  - Events with 2+ hours arrival time from around Pacific Rim
  - Time & capability to issue ‘official’ warnings
  - Much smaller than local tsunamis
  - NOAA Tsunami Warning Centers (TWCs), Dart Buoys provide useful data

- **LOCAL** Tsunamis:
  - Events with 5-30 min. arrival time & most casualties occur w/in 45 min.
  - Massive tsunamis with large inland penetration possible
  - People must be trained on life-safety protective actions & act immediately!
  - TWCs & buoys ineffective for initial life-safety actions

- ***“The time’s, they are a changin’?”***
  - M8+ EQ in the next 50-years:
    - 10 – 14 % Northern CSZ (USGS)
    - 37 % Southern CSZ (C. Goldfinger)



NEW Online Tsunami Evacuation Mapping Tool



Locate Address

Address:

Address 2:

City:

State:

Zip:

Find Address

Clear Results

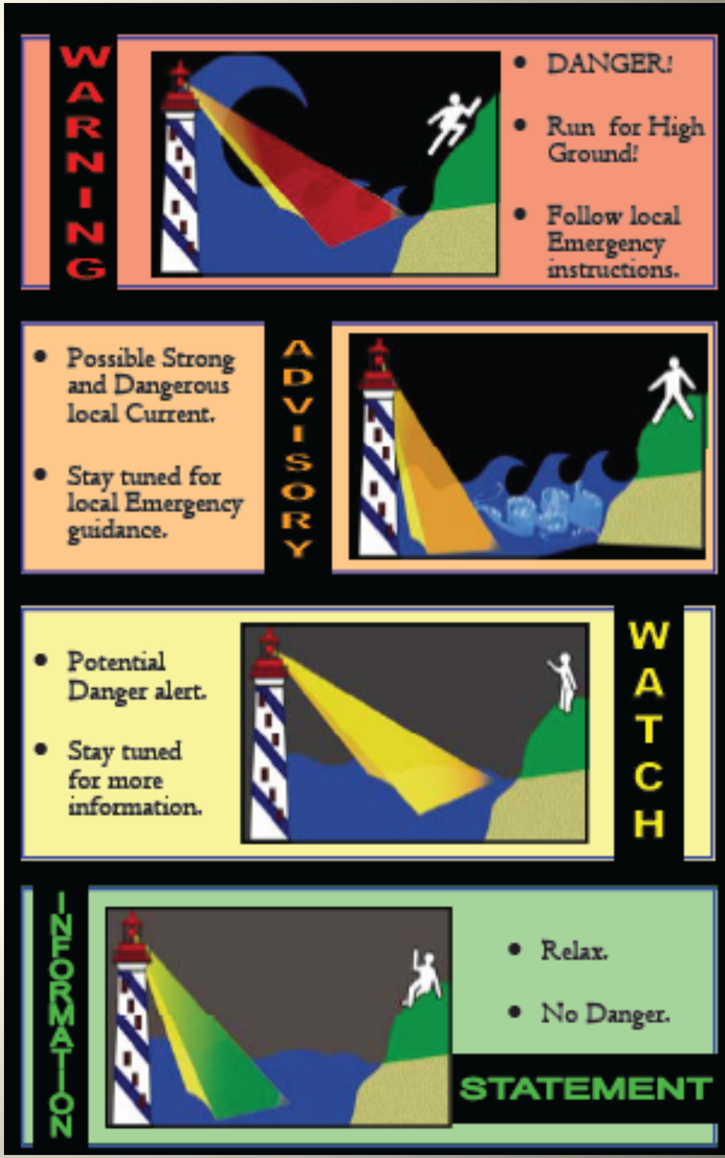
Types of Tsunami Warnings

Warning – initially based solely on seismic data, are issued as quickly as possible indicating that a significant inundation may occur.

Advisory – indicate potential beach and harbor danger; significant widespread inundation is not expected.

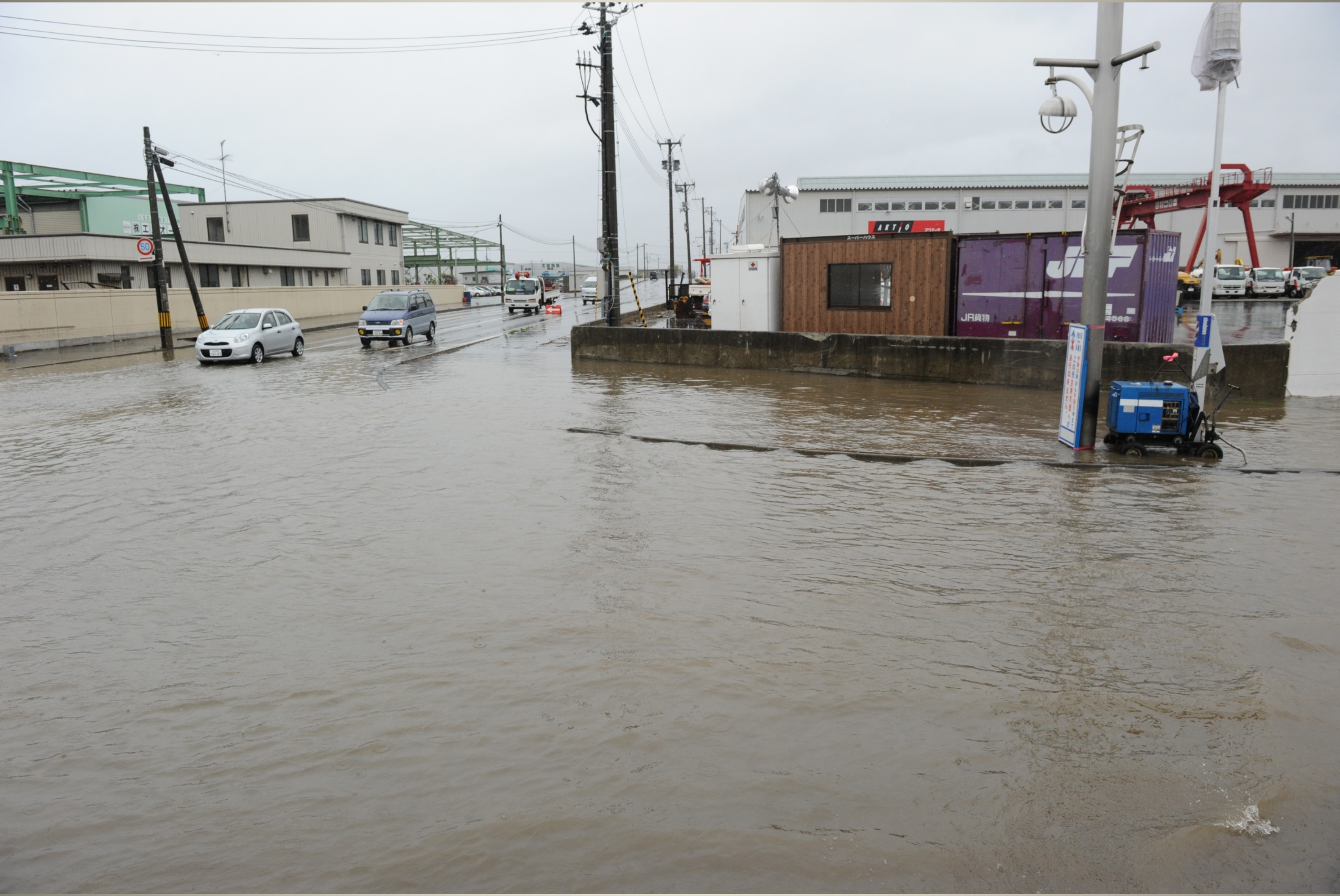
Watch – tell communities that a potentially dangerous distant event has occurred and to be alert for more information.

Information Statements are issued to reassure those experiencing an earthquake that conditions do not warrant tsunami generation.


WARNING
DANGER!
Run for High Ground!
Follow local Emergency instructions.
Possible Strong and Dangerous local Current.
Stay tuned for local Emergency guidance.
ADVISORY
Potential Danger alert.
Stay tuned for more information.
WATCH
INFORMATION
Relax.
No Danger.
STATEMENT

Lesson #4

Use common sense!


50
AKTIO
JR貨物

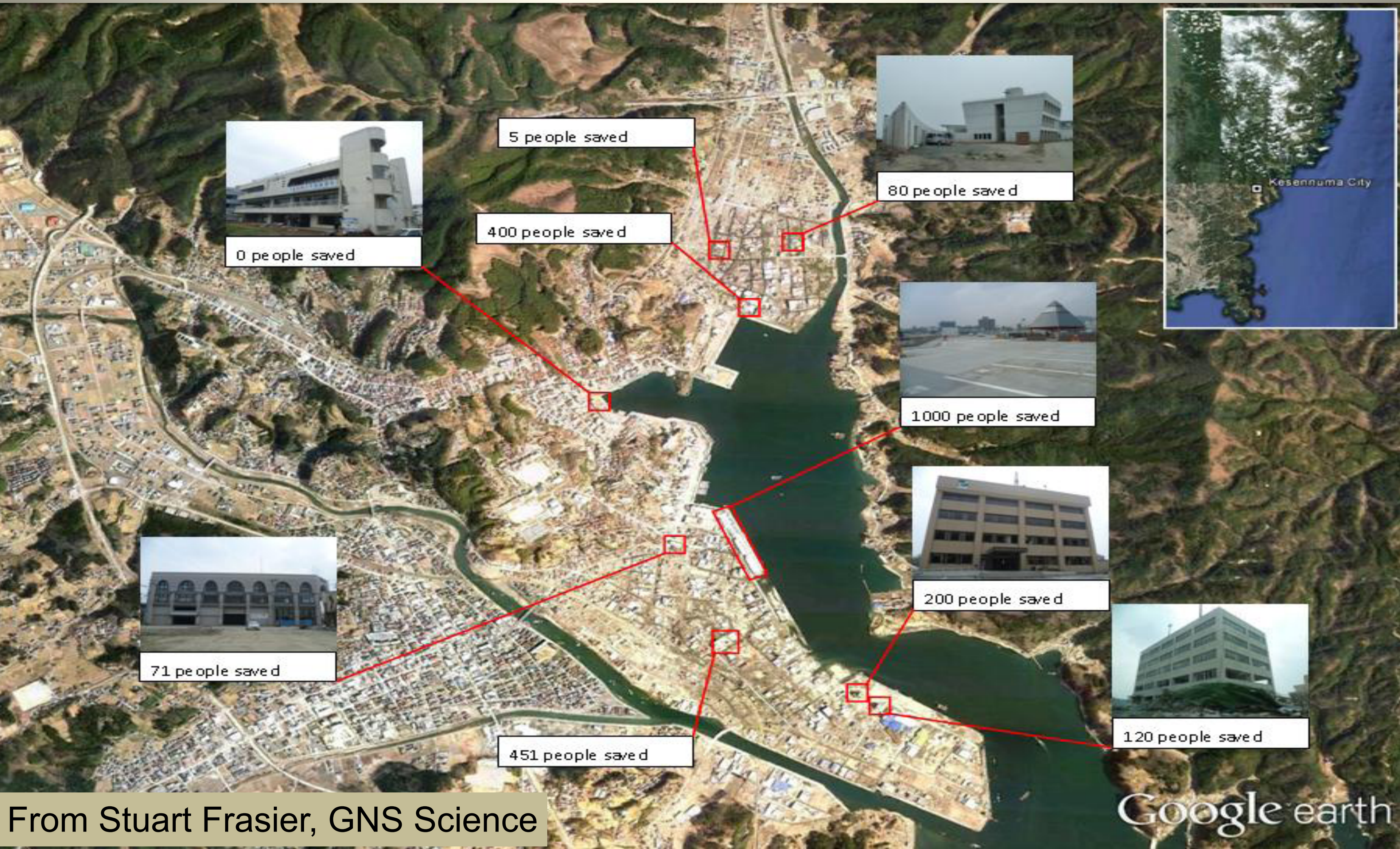
Run…Don’t Drive…to High Ground

- http://www.youtube.com/watch?v=QralDndMCeQ

Lesson #5

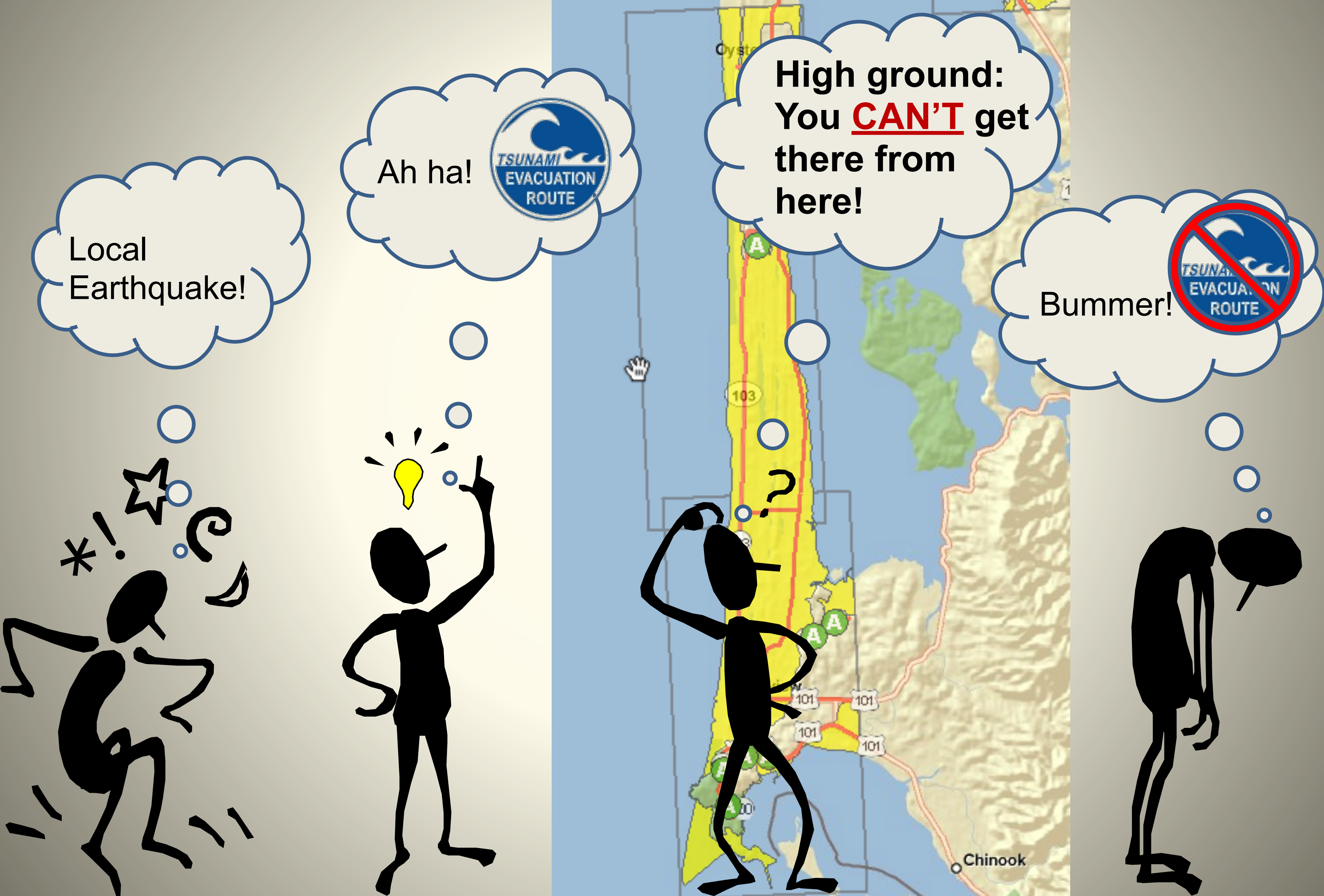
Run to High Ground when Possible – Use Vertical Evacuation when Necessary!

Kesenumma, Japan

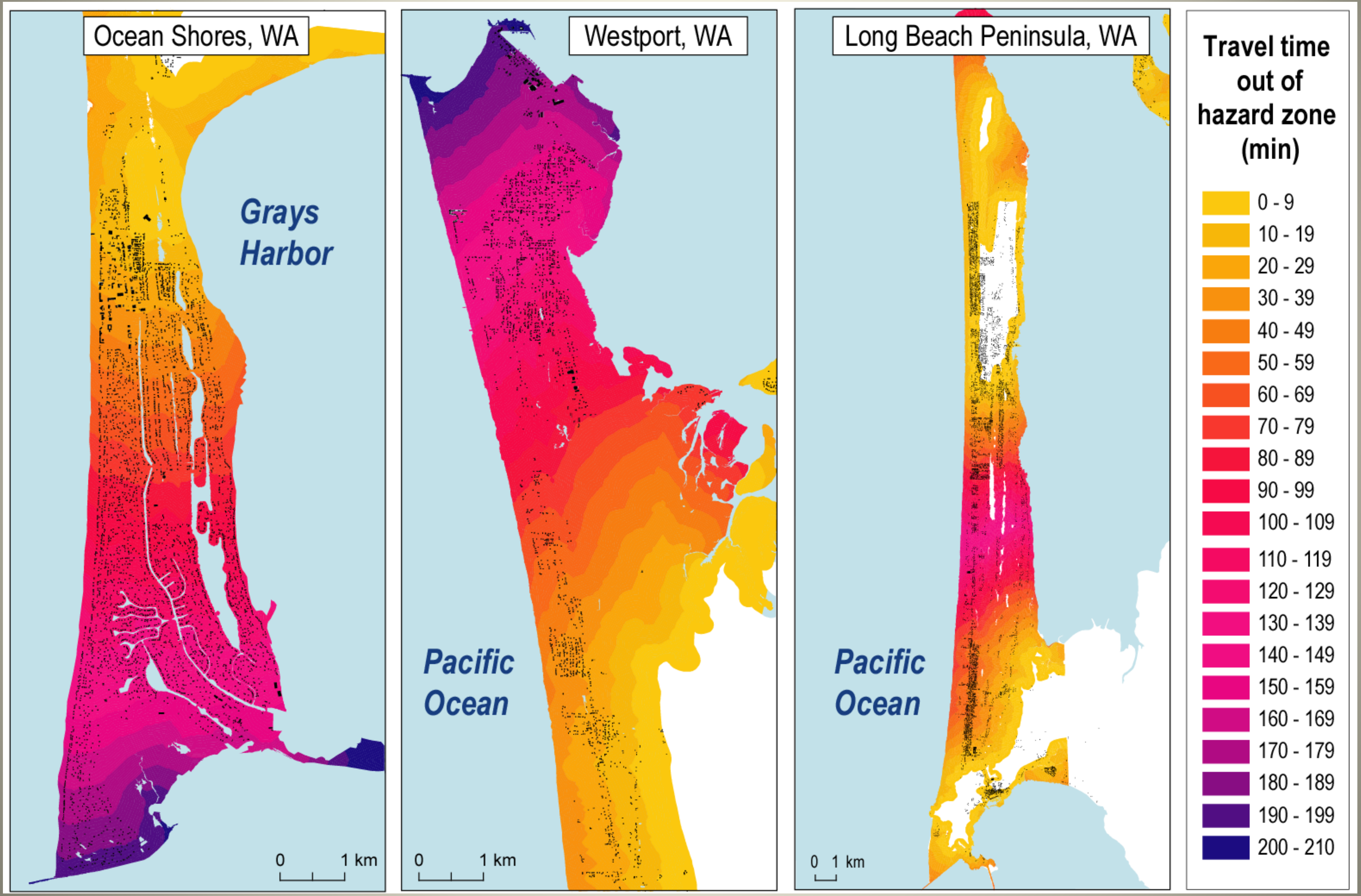


From Stuart Frasier, GNS Science

Current Situation:



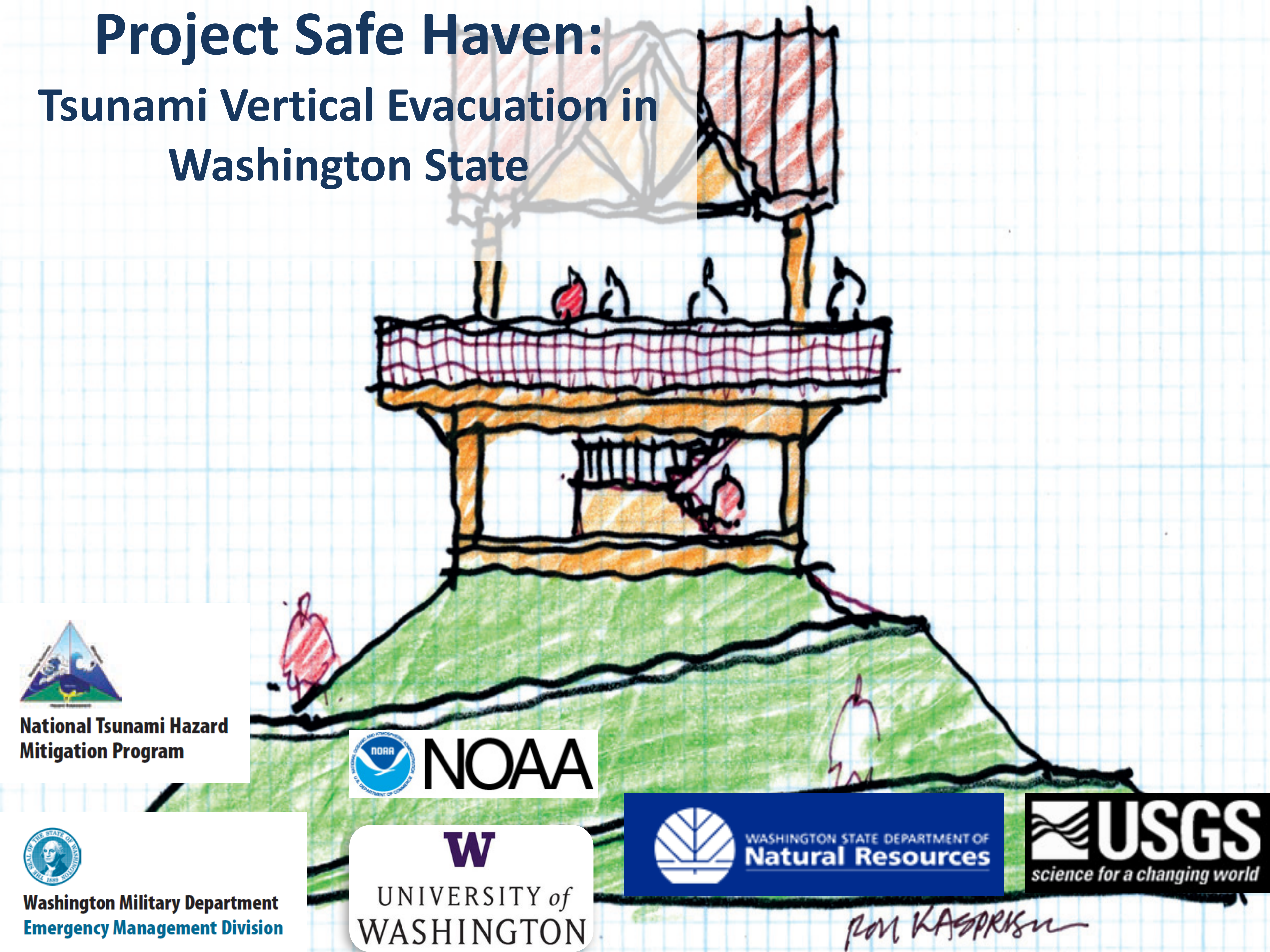
Hotspots of Evacuation Challenges



Based on 1.1 m/s travel speed

Project Safe Haven:

Tsunami Vertical Evacuation in Washington State



National Tsunami Hazard Mitigation Program

NOAA

Washington Military Department
Emergency Management Division

W
UNIVERSITY of WASHINGTON

WASHINGTON STATE DEPARTMENT OF
Natural Resources

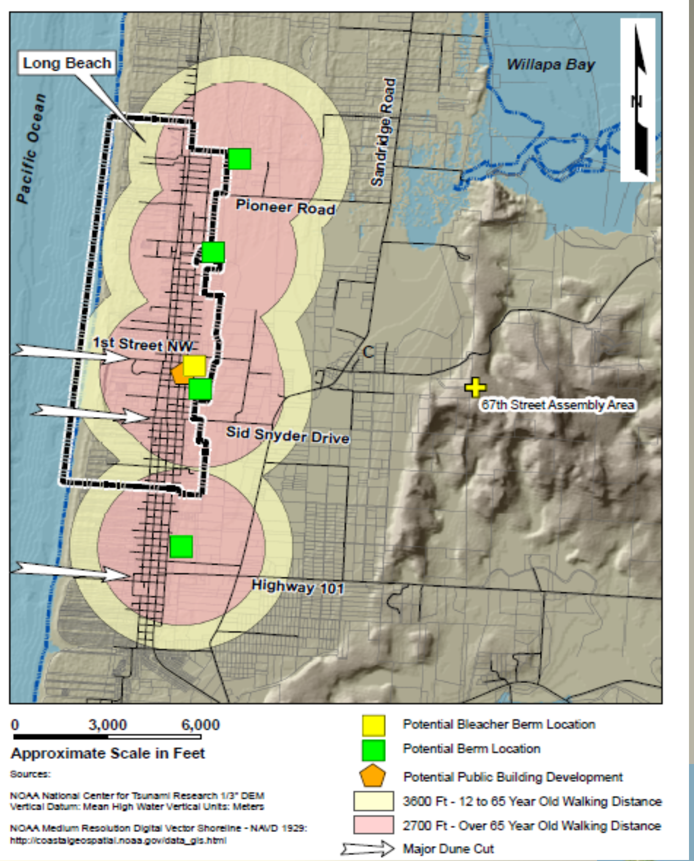
USGS
science for a changing world

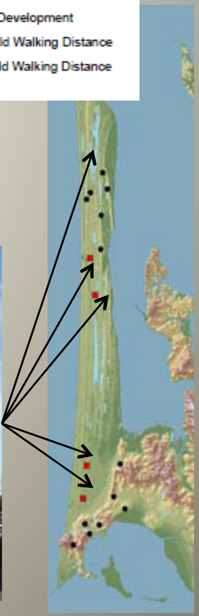
Vertical Evacuation
Safe Haven Project

- Community-based, ‘bottom-up’ approach
- All options (buildings, towers, berms, etc.) are on the table for consideration

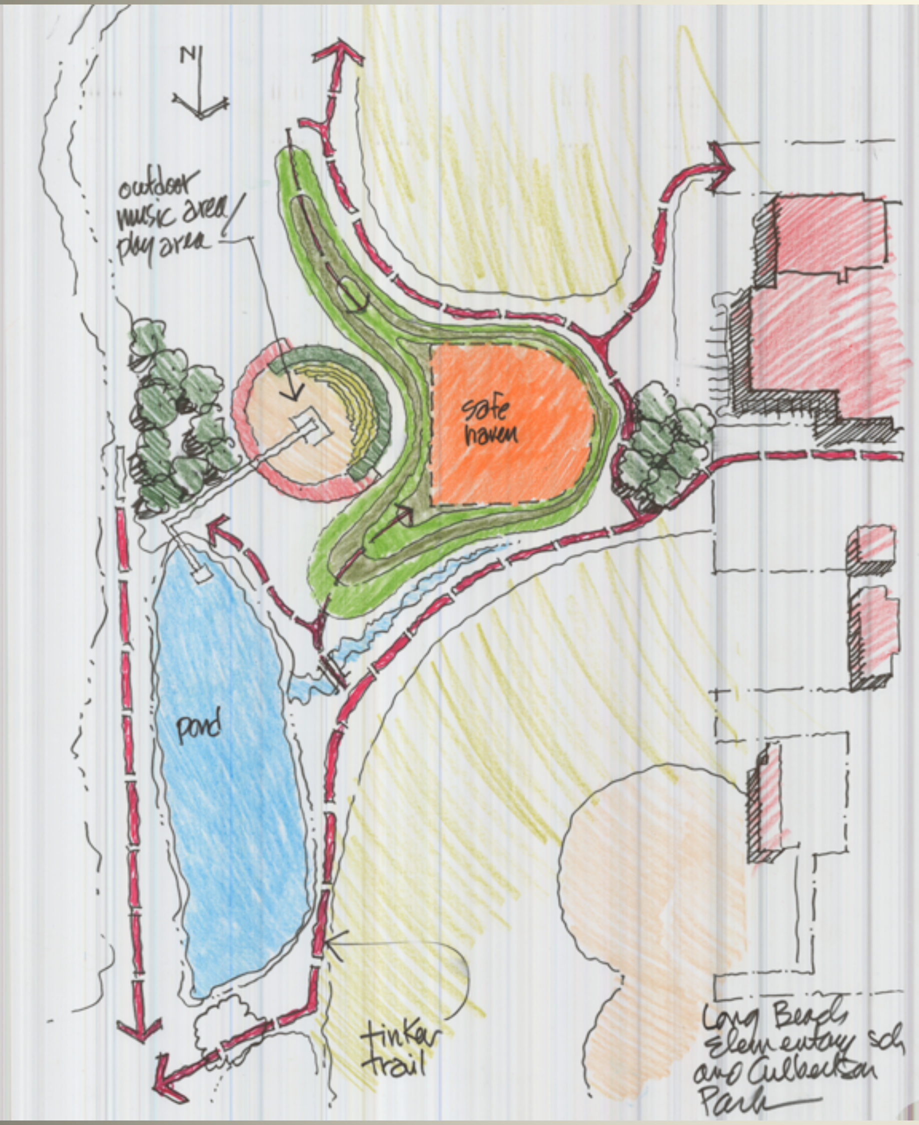
Common Themes:
- School Safety
- Seniors and special needs populations
- More conservative travel times

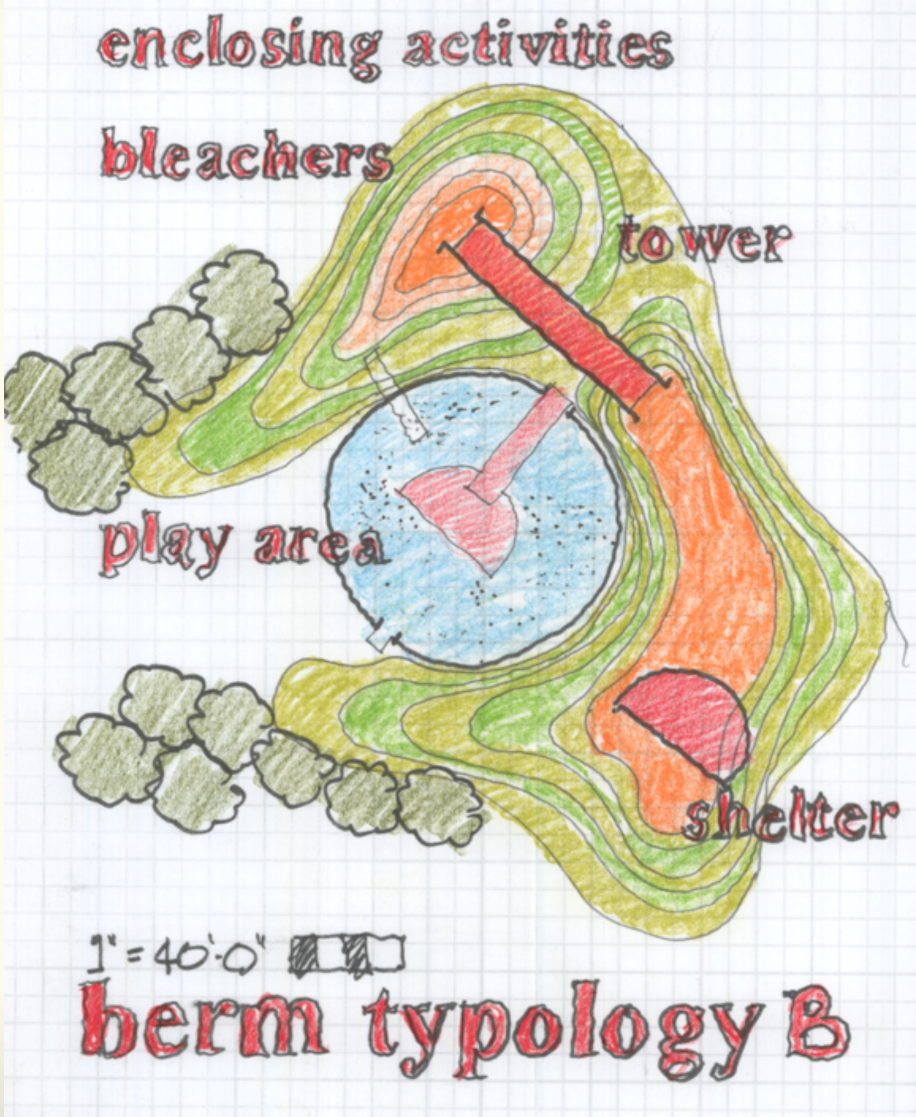
Figure 2 - Preferred Strategy


Long Beach
Pacific Ocean
Willapa Bay
N
Sandridge Road
Pioneer Road
1st Street NW
C
67th Street Assembly Area
Sid Snyder Drive
Highway 101
0
3,000
6,000
Approximate Scale in Feet
Sources:
NOAA National Center for Tsunami Research 1/3" DEM
Vertical Datum: Mean High Water Vertical Units: Meters
NOAA Medium Resolution Digital Vector Shoreline - NAVD 1929:
http://coastalgeospatial.noaa.gov/data_gis.html
Potential Bleacher Berm Location
Potential Berm Location
Potential Public Building Development
3600 Ft - 12 to 65 Year Old Walking Distance
2700 Ft - Over 65 Year Old Walking Distance
Major Dune Cut

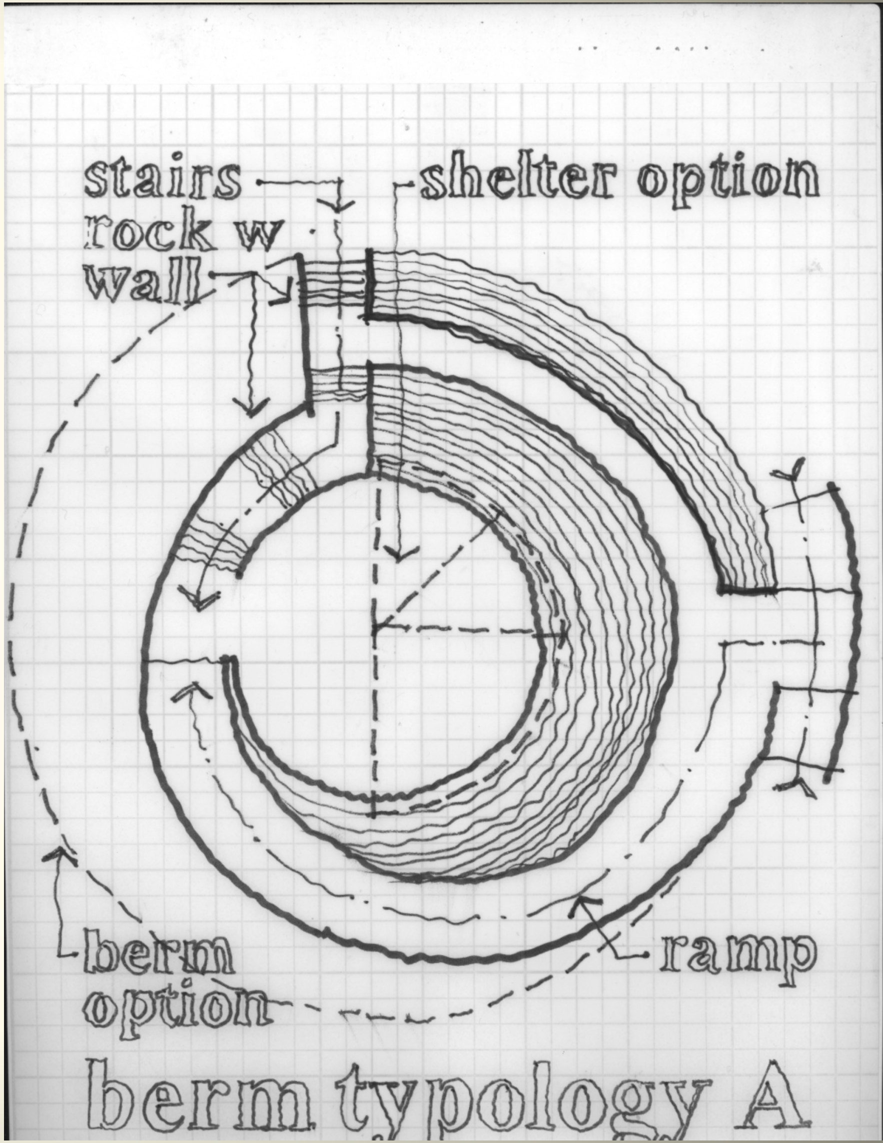


Safe Haven Berms

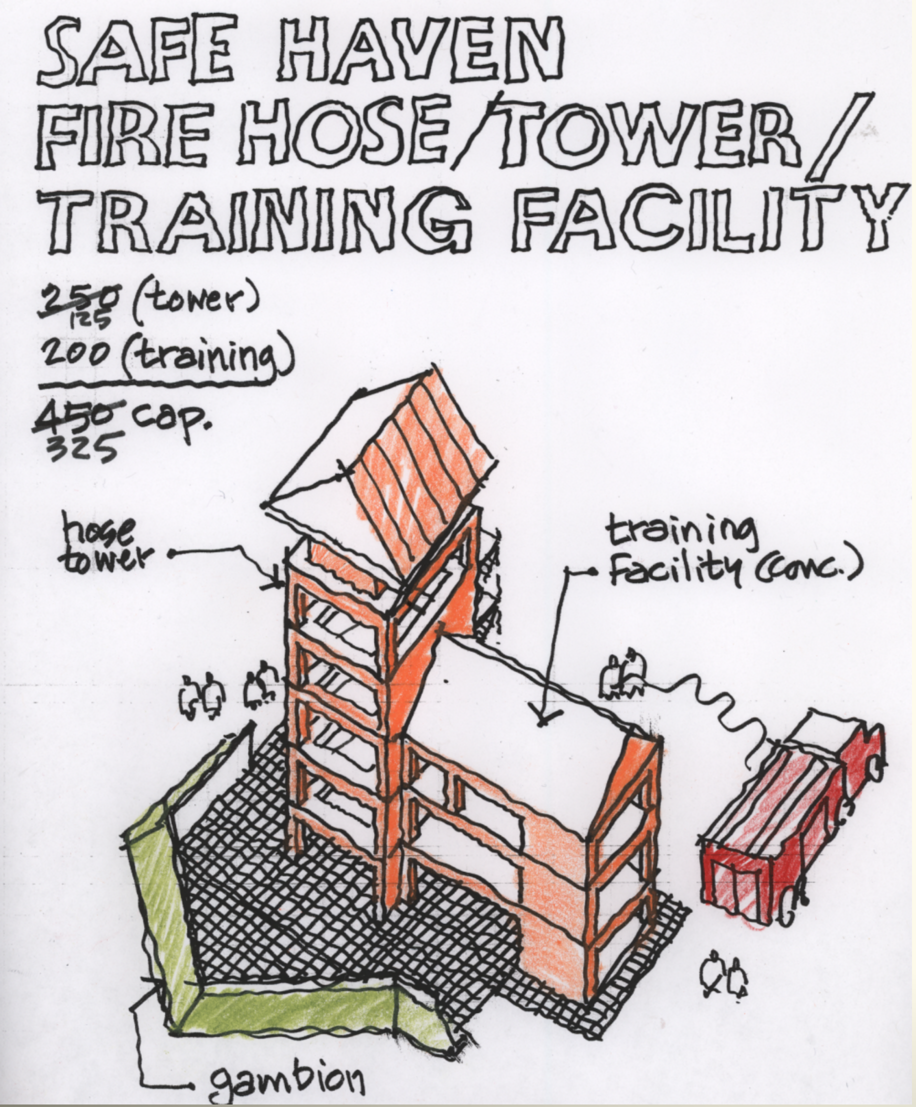

N
outdoor music area/ play area
safe haven
pond
tinker trail
Long Beach Elementary sch and Culbertson Park

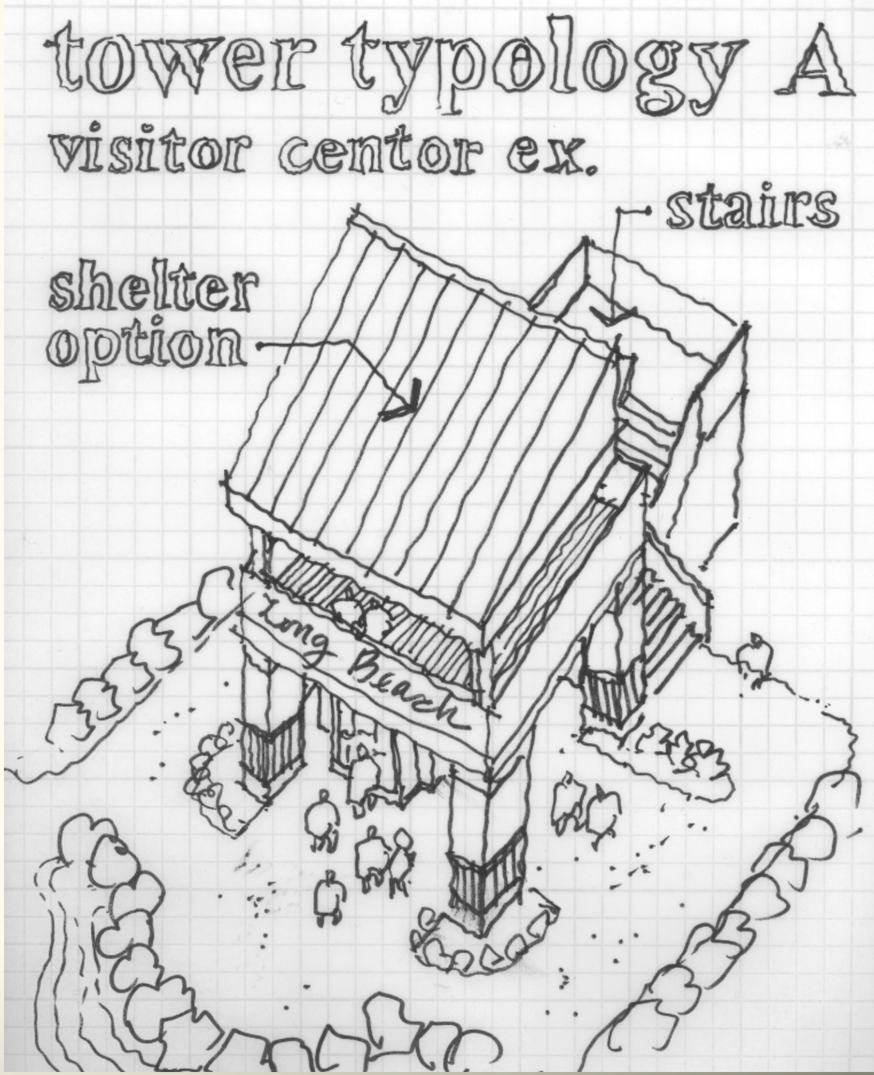


Safe Haven Berms

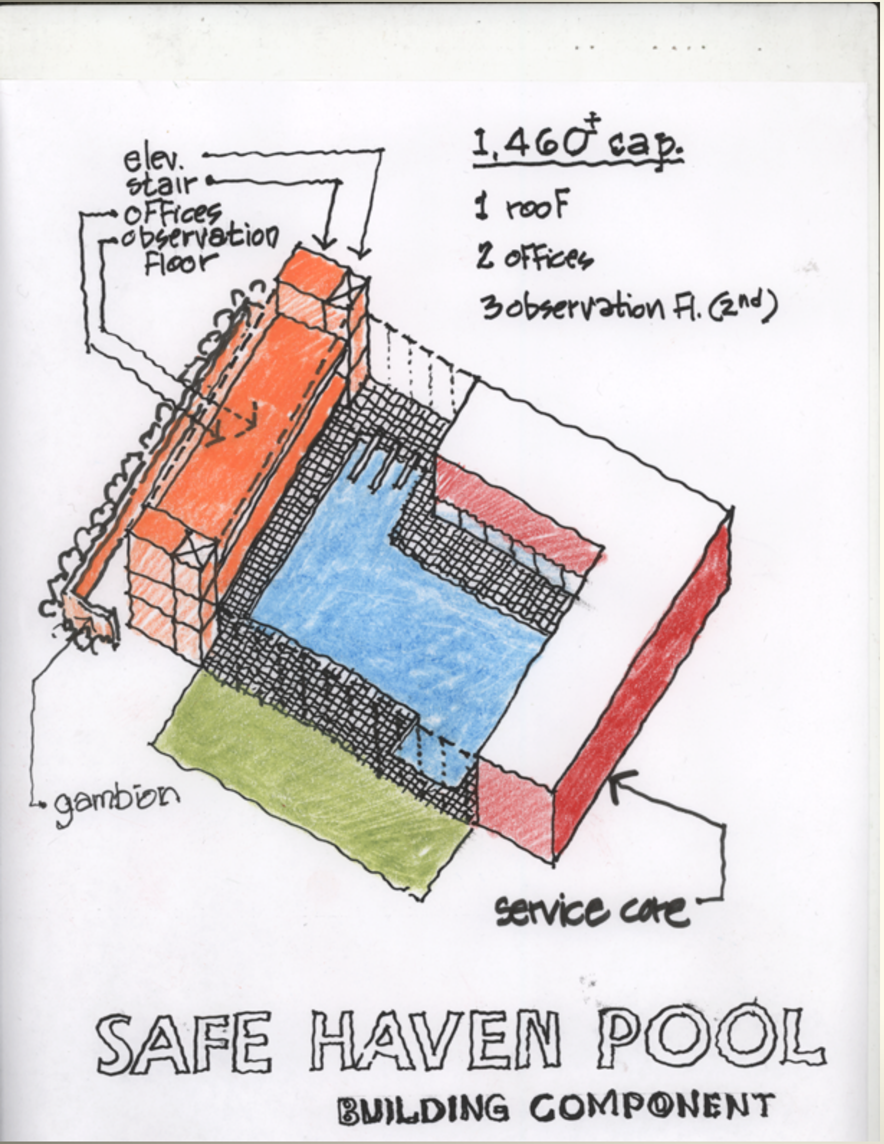


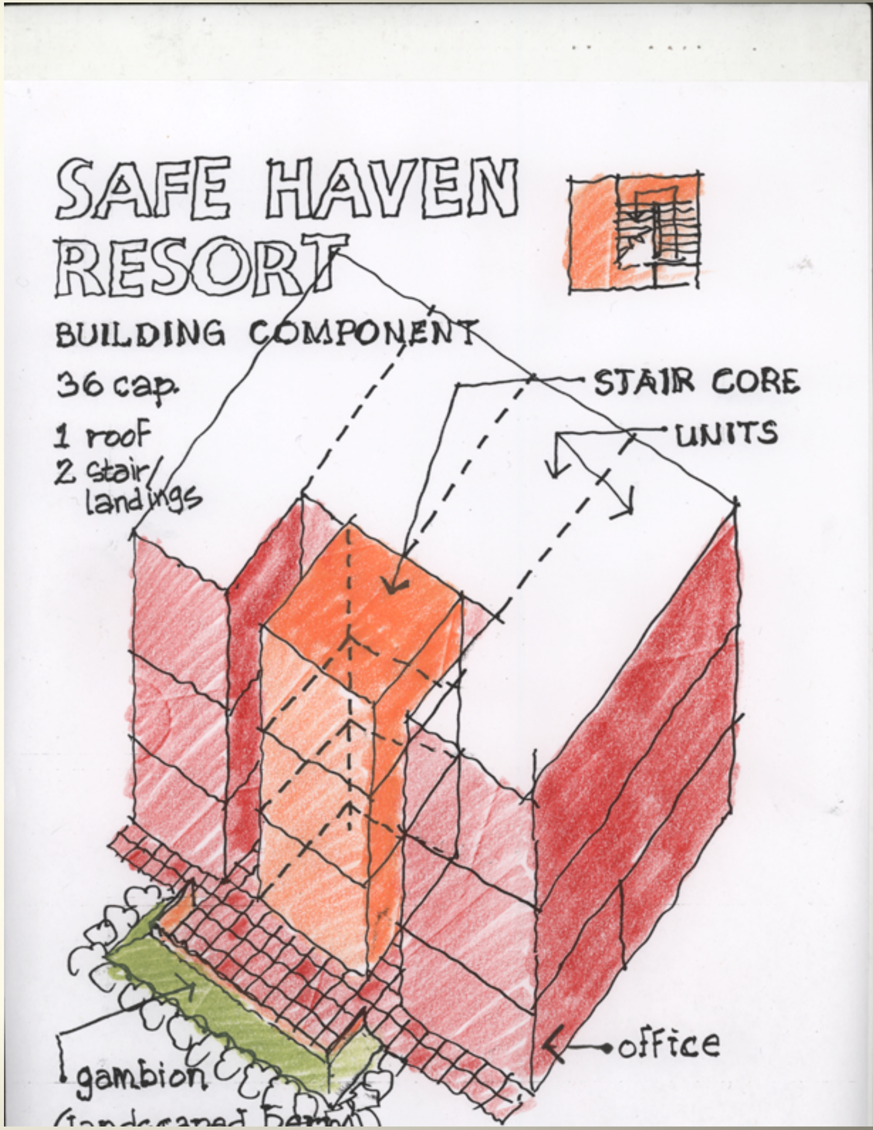
Safe Haven Towers

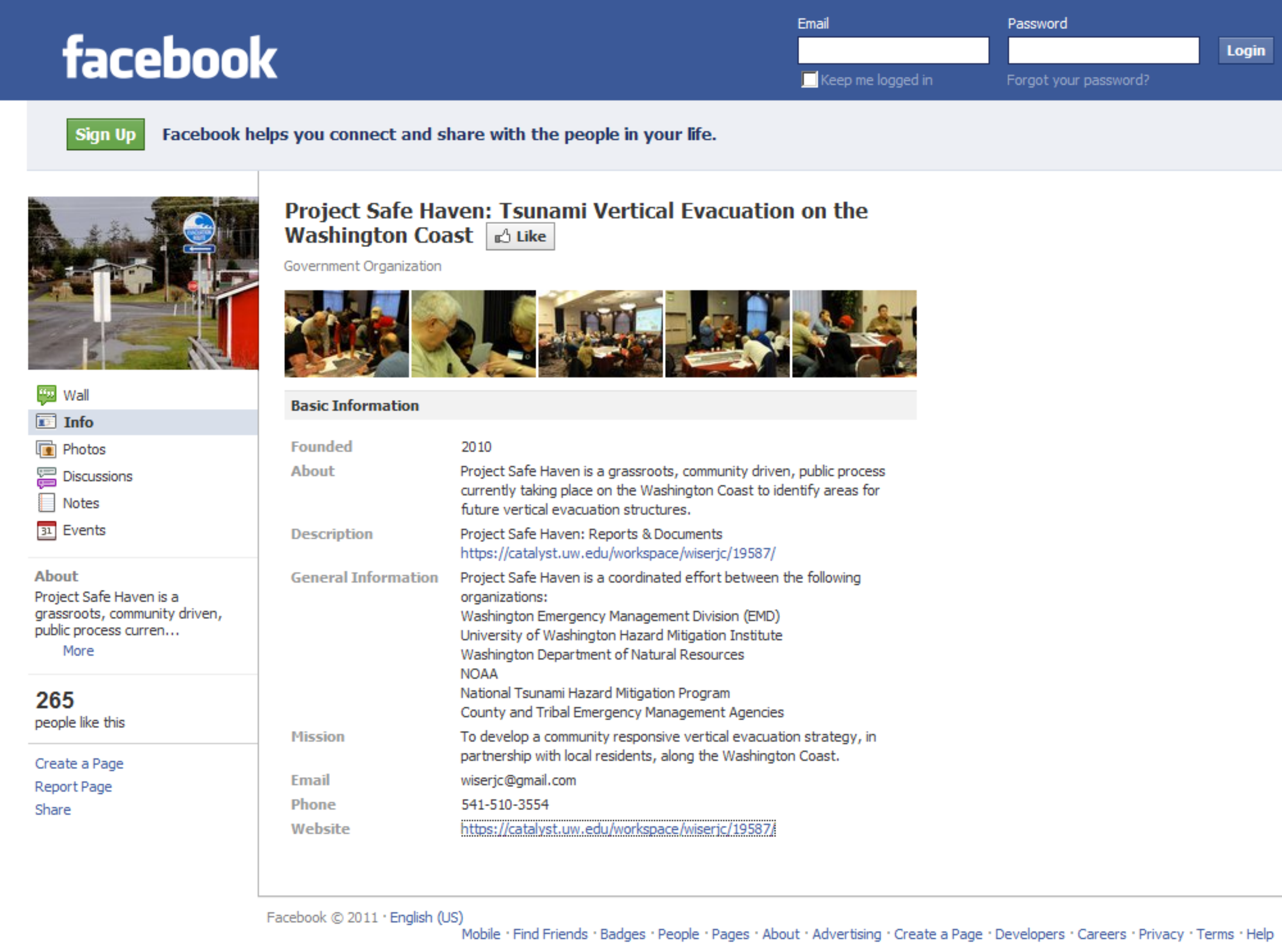




Safe Haven Buildings







Facebook helps you connect and share with the people in your life.

About

Project Safe Haven is a grassroots, community driven, public process curren…

265

people like this

Project Safe Haven: Tsunami Vertical Evacuation on the Washington Coast

Government Organization

Basic Information

Founded	2010
About	Project Safe Haven is a grassroots, community driven, public process currently taking place on the Washington Coast to identify areas for future vertical evacuation structures.
Description	Project Safe Haven: Reports & Documents https://catalyst.uw.edu/workspace/wiserjc/19587/
General Information	Project Safe Haven is a coordinated effort between the following organizations: Washington Emergency Management Division (EMD) University of Washington Hazard Mitigation Institute Washington Department of Natural Resources NOAA National Tsunami Hazard Mitigation Program County and Tribal Emergency Management Agencies
Mission	To develop a community responsive vertical evacuation strategy, in partnership with local residents, along the Washington Coast.
Email	wiserjc@gmail.com
Phone	541-510-3554
Website	https://catalyst.uw.edu/workspace/wiserjc/19587/

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Lesson #6

Expect the unexpected… Especially during recovery!

May 9, 2011 3:23 PM

PRINT TEXT ⊟ ⊞

Japanese towns flood daily after quake "sunk" land

6 Comments Have Your Say | **Email Story** Send to a Friend | **Share This** Tell Your Friends | **Tweet This** Tweet This | **More** Share It

Itsuki Mogi, 11, left, and and Umi Mogi, 12, watch the moving sea water in a street in front of their house in Ishinomaki, Miyagi Prefecture, Japan, May 3, 2011. (AP Photo/Junji Kurokawa)

Disaster In Japan

- Japan earthquake: before and after
- Search and Rescue in Japan
- Quake, tsunami slam Japan
- Lanterns fly in Japan to honor Tsunami victims
- Japan's tsunami: Six months later

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Yes, I'll help or N
Responses are anonymous, view ou

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Lesson #7

We cannot rely on technology alone!

"The first tsunami warning issued by JMA at 14:49 LT for a *M7.9 quake* predicted inundation heights of 3 meters in Iwate and Fukushima and 6 meters in Miyagi. ***This was the only warning that local residents were able to receive due to the immediate destruction of the regional power supply system.***

JMA updated and revised the tsunami warning at 15:15 LT to 6 meters in Iwate and Fukushima and 10 meters in Miyagi. This warning was followed by an updated warning at 15:30 LT for a 10-meter tsunami for all areas.

However, these warnings never reached the majority of the local populace. Thus, some residents went to the nearest evacuation sites expecting a relatively small tsunami, while others thought the tsunami would cause only a small flood and took time to clear fallen debris before evacuating on foot or by car. In fact, the 10-to 20-meter- high tsunami struck most of the interview areas between about 15:25 and 15:35 LT."

Source: M. Ando, M. Ishida, Y. Nishikawa, C. Mizuki, and Y. Hayashi

“Public education without technological systems works great…

Technological systems without public education does not…

Best to have both…”

-Dr. Lori Dengler, Humboldt State University

Lesson #8

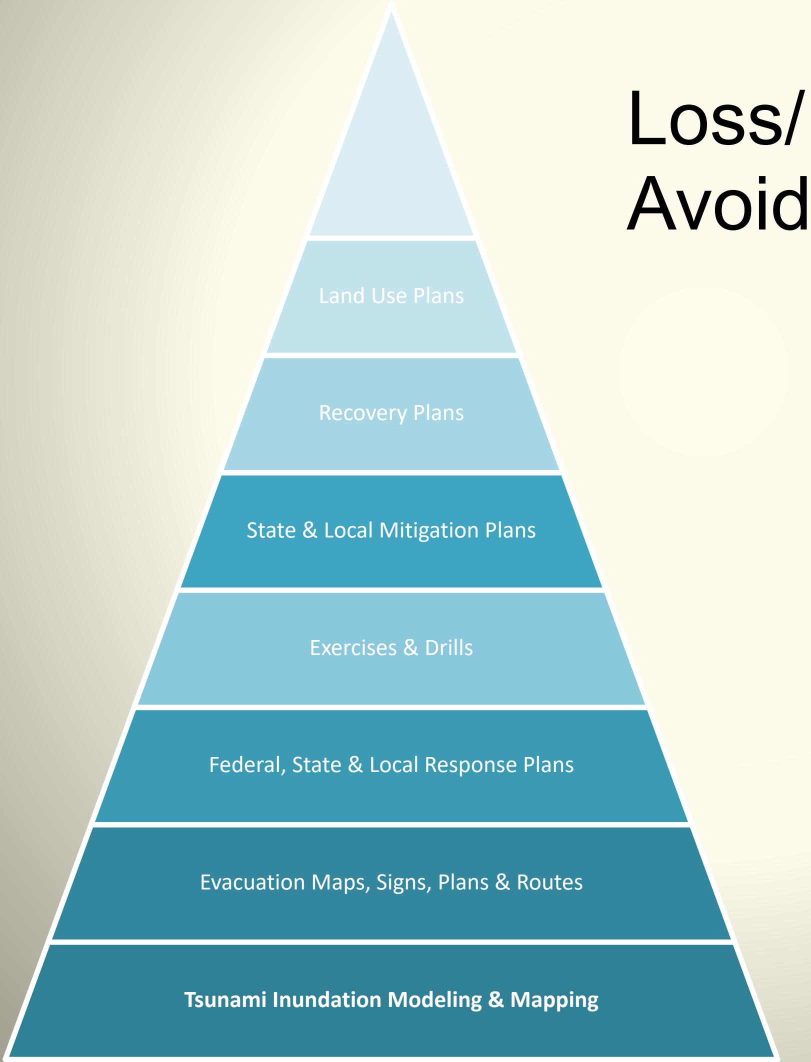
We must plan for the “The Post-Disaster Landscape”!

The Japanese authorities estimate a staggering 25 million tons of debris was generated in the three worst-affected prefectures. This is many times greater than the amount created by the 2010 Haiti

Much of the rubble and waste has been cleared from the streets, but the Japanese environment ministry last month revealed only 5% had been disposed of and 72% was still being stored at temporary sites.

Once the debris is cleared…then what?

We MUST incorporate the Post-Disaster Landscape into our Pre-Event Land Use Planning



Land Use Plans

Recovery Plans

State & Local Mitigation Plans

Exercises & Drills

Federal, State & Local Response Plans

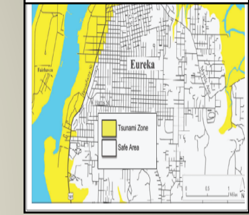
Evacuation Maps, Signs, Plans & Routes

Tsunami Inundation Modeling & Mapping

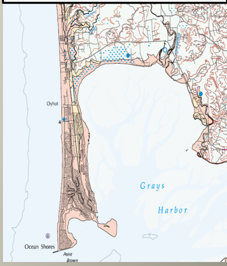
Loss/Risk Avoidance

Loss/Risk Reduction

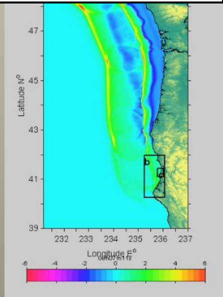
Evacuation Maps



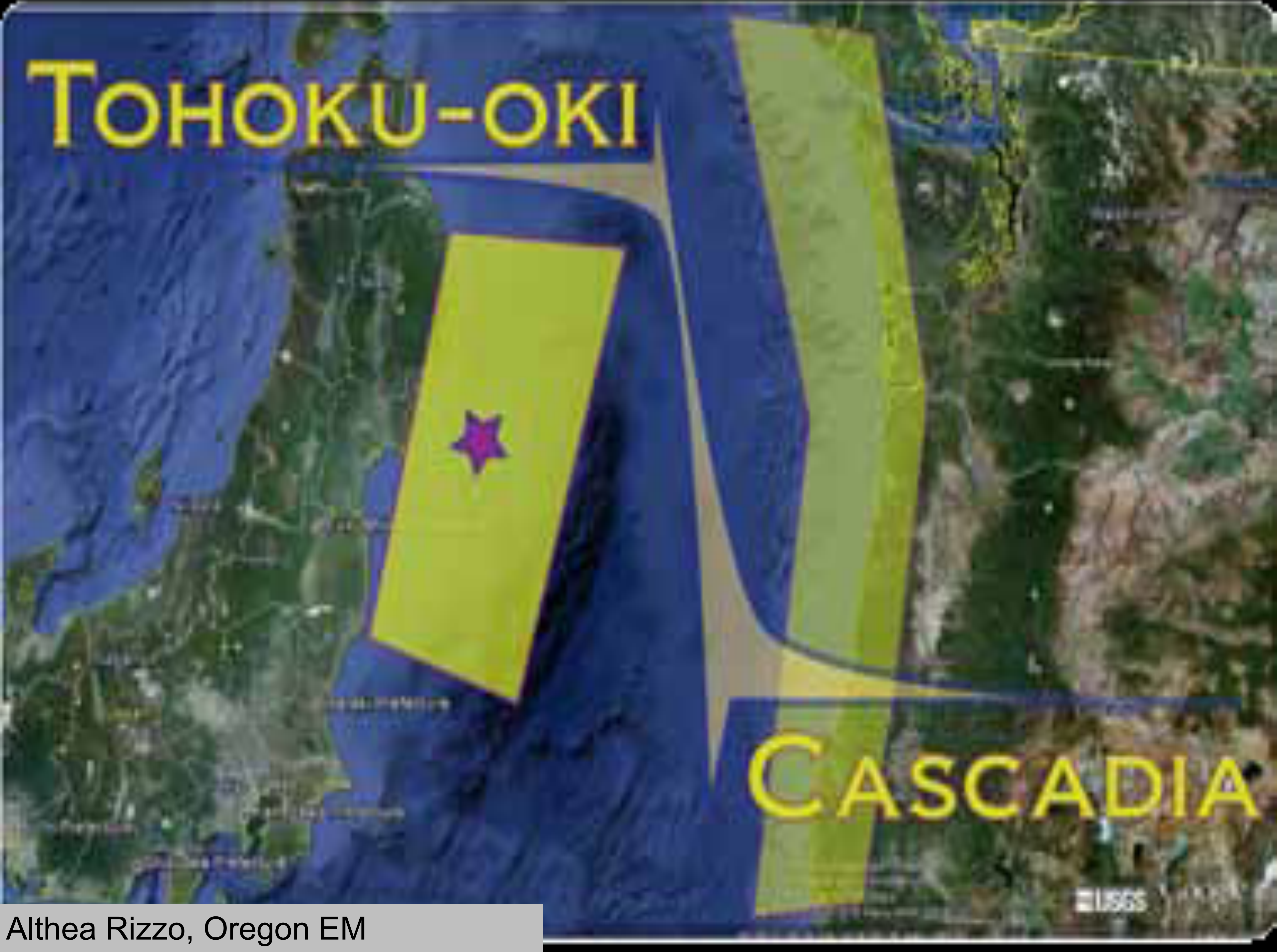
Inundation Maps



Modeling



Lesson #9
We MUSTStart
TODAY!



Althea Rizzo, Oregon EM

Because TODAY, our Estimated Population at Risk in Cascadia-related Tsunami Hazard Zones is…

Population Counts	Washington	Oregon	Northern California	Regional Total
Number of Residents	44,710	22,201	10,344	**77,255**
Number of Employees	17,021	14,857	9,389	**41,267**
Average Daily State Park Visitors	17,029	53,714	2,889	**73,632**
Totals	**78,760**	**90,772**	**22,622**	**192,154**

Number of Visitor Facilities	Washington	Oregon	Northern California	Regional Total
Number of Public Venues	135	60	67	**262**
Number of Dependent-care Facilities	149	43	32	**224**
Totals	**284**	**103**	**99**	**486**

science for a changing world

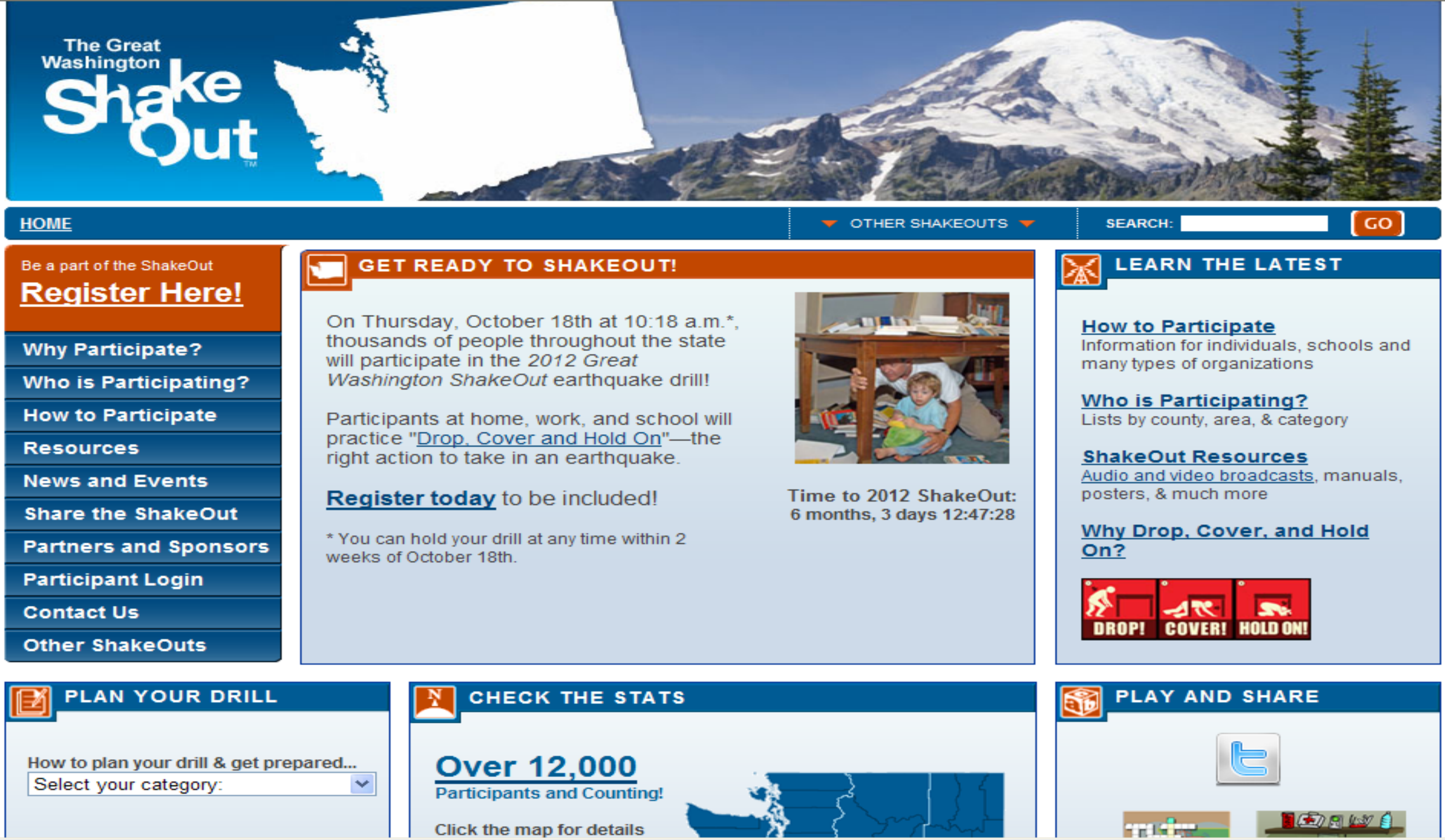
** Assuming there are 100 people at a public venue and 50 people at a dependent-care facility, then there are approximately another 37,400 people in tsunami-prone areas.*

*** Numbers compiled from various USGS reports on community exposure to tsunamis (Oregon is based on 2000 data; Washington and California are based on 2010 data)*

N. Wood, 2012

Doing these simple things could make a difference in how you survive:

- Have a family disaster plan
- Have an out of area contact
- Know what to do: Drop, Cover, and Hold On



Be a part of the ShakeOut
Register Here!

GET READY TO SHAKEOUT!

On Thursday, October 18th at 10:18 a.m.*, thousands of people throughout the state will participate in the *2012 Great Washington ShakeOut* earthquake drill!

Participants at home, work, and school will practice "Drop, Cover and Hold On"—the right action to take in an earthquake.

Register today to be included!

* You can hold your drill at any time within 2 weeks of October 18th.

Time to 2012 ShakeOut:
6 months, 3 days 12:47:28

LEARN THE LATEST

How to Participate
Information for individuals, schools and many types of organizations

Who is Participating?
Lists by county, area, & category

ShakeOut Resources
Audio and video broadcasts, manuals, posters, & much more

Why Drop, Cover, and Hold On?

PLAN YOUR DRILL

How to plan your drill & get prepared...
Select your category:

CHECK THE STATS

Over 12,000
Participants and Counting!

Click the map for details

PLAY AND SHARE

www.shakeout.org/washington

What you do TODAY will determine how you and your family survive and how rapidly you recover from an earthquake an tsunami.

When an earthquake and/or tsunami hits, your family will be counting on you to get them through the moment and help them after the event

YOU will be CONFIDENT & have greater PIECE OF MIND, knowing that you are ready to ACT and have done all you can do to PREPARE.

BE WASHINGTON'S *NEXT* SURVIVAL STORY!